

Prevalence of mind mapping as a teaching and learning strategy in physical therapy curricula

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Abstract: Background and Purpose. Regardless of our discipline educators seek to create environments that actively engage students in their learning journey. One teaching and learning strategy that has emerged in higher education is mind mapping (MM). The purpose of this exploratory study was to determine the prevalence of MM usage in a health science professional curricula “physical therapy” and to determine if a relationship exists between faculty knowledge of mind maps and their use of the technique. *Subjects/Methods.* All Commission on Accreditation in Physical Therapy Education (CAPTE) accredited US physical therapist education program chairs (191) were emailed a request to participate in an on-line survey exploring the use of and knowledge of mind maps. The link to the survey was embedded in the email for direct access by the participants and was anonymous. *Results.* Of the 191 physical therapist program chairs surveyed, 55 completed responses were received. Of the 55 respondents only 10.9% ($n=6$) reported using MM within their curriculum while 89.1% ($n=49$) did not. For the 49 programs not using MM, 56.4% stated that their program faculty would be interested in using MM. Participants open ended responses support four major themes regarding faculty lack of MM utilization, with limited awareness identified as the greatest barrier. *Discussion/Conclusion.* The findings from this exploratory study support that MM is not used in many physical therapist education programs primarily due to faculty’s lack of awareness. Interestingly, faculty would be interested in exploring its utility if they understood MMs tenets and relevance as a teaching and learning strategy.

Keywords: *mind mapping, physical therapy, health sciences, teaching strategy*

I. Introduction.

As educators, creating an environment that develops a students’ critical thinking ability is one of our primary roles. One teaching and learning strategy that has recently emerged in higher education as a means to support student critical thinking is the nonlinear learning technique of mind mapping (MM) (Pudelko, 2012). Mind mapping, with its inter-related branching links information and is suggested to support a deeper level of thinking. While MM teaching and learning strategy has emerged in the literature, its use by physical therapist educators is unknown (Pudelko, 2012). The purpose of this exploratory study was to determine the prevalence of mind mapping usage in the education of physical therapist students. Research questions included: (1) Do faculty utilize mind maps in all CAPTE accredited physical therapist education programs?

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(2) If faculty do use mind maps, how are they used? (3) How does faculty define mind maps? (4) How does faculty define concept maps? and (5) Is there a relationship between faculty knowledge of mind maps and their use of the technique?

Review of literature. Mind maps are often confused with concept maps, which have been widely utilized in primary and secondary educational environments to promote critical thinking skills using a linear learning approach (Eppler, 2006). Concept maps have been used across the academic landscape including in the preparation of many health professionals including, nursing (Beitz, 1998) and medicine (Hoffman, Trott, & Neely, 2002). Numerous benefits resulting from the utilization of the concept map based upon its visual representation of information which fosters what Novak termed a “graphic re-construction of knowledge have been noted” (Novak & Canas, 2012). The tenets associated with concept mapping are supported by the cognitive learning theory that suggests that meaningful learning links new knowledge to prior knowledge (Ausubel, Novak, & Hanesian, 1986). Further supporting concept maps is the constructive theory of learning which suggests that in order to make sense of one’s experiences “meaning” must be attached to the experience. In concept maps, “meaning” is associated to information through graphic reconstruction and representation (Vacek, 2009). Upon visual observation of concept maps a hierarchical process is noted which resembles the tightly structured format of an outline. It is through these connections that the concept map developer demonstrates a perceived relationship between ideas (Figure 1).

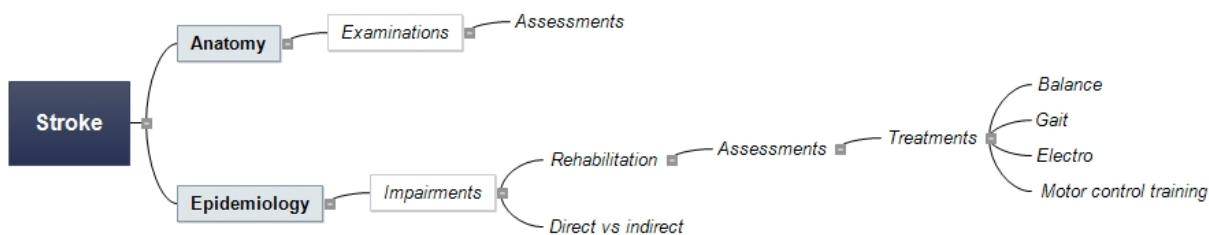


Figure 1. Illustrates a concept map on the assessment and treatment of stroke from a rehabilitative perspective. The map has two major themes presented in a linear fashion: theme 1 focuses on *epidemiology* and theme 2 on *anatomy*. Several sub themes are also presented in the map: *rehabilitation*, *examination* and *impairments*

Using the same underlying theoretical premise as that of concept maps is another teaching and learning strategy, “mind map”. Mind mapping (MM) which is referred to as a “visual, non-linear learning technique” (Davis, Sumara, & Luce-Kaper, 2000) has only recently been investigated in the literature. This visually displayed non-linear approach to learning engages the learner in thinking and exploring concepts using visuospatial relationships and pictorial depictions in a non-linear manner. In mind mapping these relationships emerge from one central key theme by using peripheral branching. The number and location of these branches are reflective of the mappers understanding of important notions, ideas, and concepts associated with the central theme. Further inter-connecting of these notions, concepts and ideas result in cross connections across a radius of 360 degrees. It is this free flowing 360 degree radius that enables the mapper to seek and explore to the fullest the relationships associated with the material presented and thus make deeper and richer connections.

D'Antoni et al. (2011) further describes mind maps based upon the work of Buzan and Buzan (1993) who suggested that a mind map should be drawn on blank paper that is larger than standard 8 ½ by 11-inch paper allowing one to move outside the boundaries of conventional size paper. The use of multi-color and textured pens and pencils as writing implements are also encouraged as they afford the mapper a means by which to express themselves more creatively. The central positioning of the topic of interest allows the mapper the ability to develop and explore concepts and relationships using branches and sub-branches which contain pictures and key phrases (major themes presented). Pictures and phrases are key as they offer a mechanism to aid in information recall by creating a meaningful non-linear representation for oneself (Figure 2). This meaningful self-identified information representation supports a richer and deeper integration of information supporting both declarative (explicit) and non-declarative procedural (implicit) knowledge (Ambrose et al., 2010).

Several disciplines including Marketing (Erickson & Hauer, 2004), Economics (Nettleship, 1992), Finance (Biktimirov & Nilson, 2006), Executive Education (Mento, Martinelli, & Jones, 1999), Medicine (D'Antoni et al., 2010; Farrand, Hussain, & Hennessy, 2002), and Physical Therapy (Pinto Zipp, Maher, & D'Antoni, 2009) have begun to utilize mind mapping as a teaching and learning tool. Specifically in medical students Farrand et al. (2002) found both short term recall ($p=.016$) and long term ($p=.013$) factual recall was significantly better in their student group ($n=50$) using mind maps when compared to the traditional self-study group. Conversely, the work of Wickramasinghe et al. (2007) using mind mapping in medical students did not support Farrand's positive findings of MM on short-term memory.

Investigating if a relationship exists between mind mapping and critical thinking, D'Antoni et al. (2010) randomly assigned 131 first-year medical students to a standard note-taking (SNT) group or mind map (MM) group and found no significant differences in either critical thinking or content knowledge scores on the pre- and post-quizzes between the two types of note taking groups. The authors suggested that limited exposure to mind mapping did enable "novice" mind mappers the tools necessary to effectively grasp the material presented as they performed similarly to SNT subjects.

While the effectiveness of MM as a teaching and learning strategy has not been investigated in physical therapy students, Pinto Zipp et al. (2009) did explore physical therapy students' perceptions regarding the effectiveness of the mind mapping learning technique as a means to support their organization, prioritization, and integration of material course material. In this study, students perceived that mind mapping enabled them to organize material (38%), prioritize information (9.5%), and integrate course material (33.3%). Interestingly, the course faculty ($n=2$) did perceive that mind mapping improved student organization, prioritization, and integration of course material.

Although the authors have utilized mind mapping for over 6 years within a neurological rehabilitation course within a Physical Therapy program, objective measurement of MM supporting critical thinking has not been measured. Based upon the limited information on the utilization of MM in higher education and the presence of only several studies published specifically in the health professions literature (D'Antoni et al., 2010; Farrand, Hussain, & Hennessy, 2002; Pinto Zipp, Maher, & D'Antoni, 2009; Wickramasinghe et al., 2007; Pudelko, 2012) exploring mind mapping as a teaching and learning strategy in professional education the authors sought to first gain an awareness of the extent of its use specifically in physical therapist education programs.

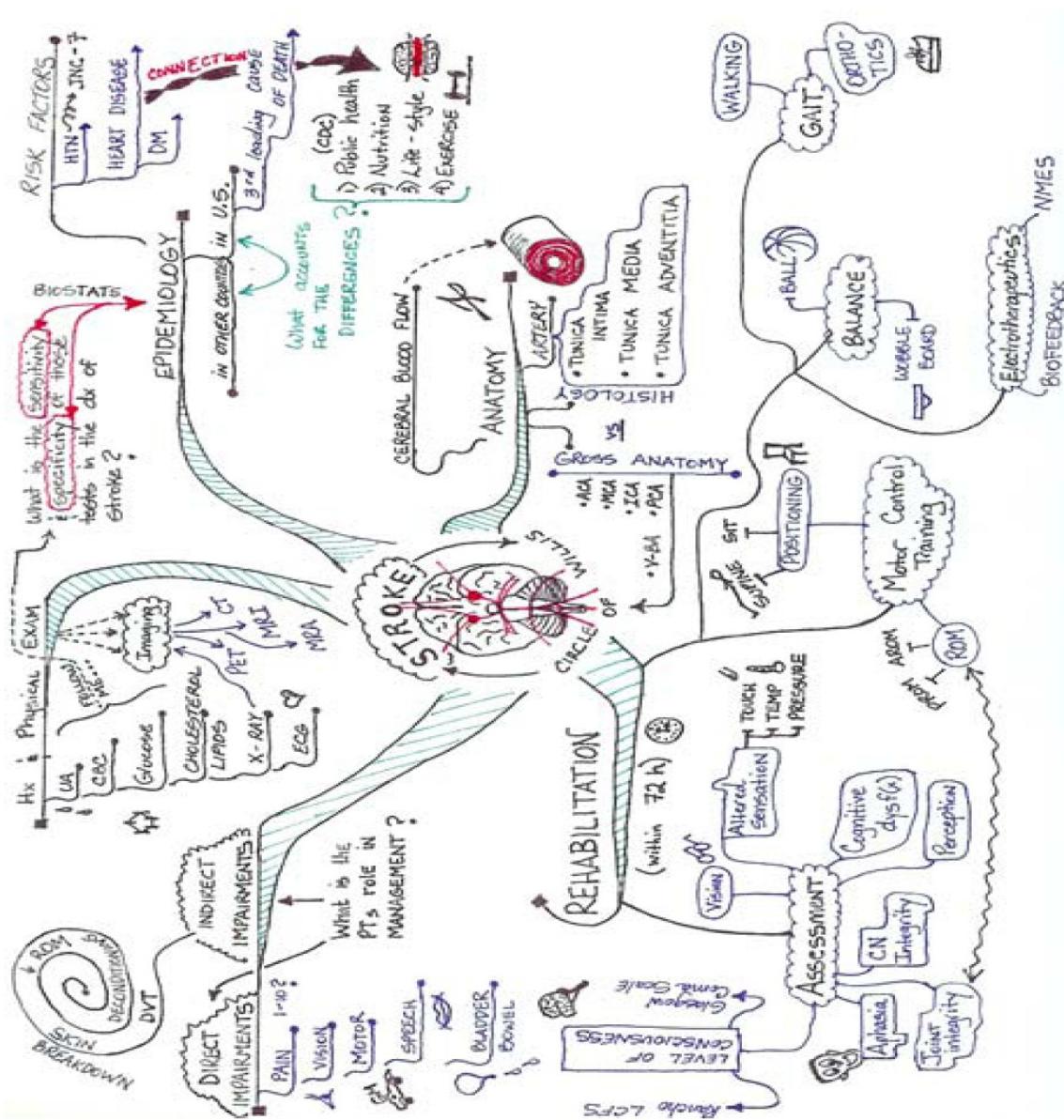


Figure 2. Illustrates one type of mind map on the assessment and treatment of stroke from a rehabilitative perspective. The map can be visualized as having four quadrants in a clockwise fashion: quadrant 1 focuses on *epidemiology*, quadrant 2 on *anatomy*, quadrant 3 on *rehabilitation*, and quadrant 4 on *history, physical examination, and impairments*. (Taken with permission from: D'Antoni, A. V., & Pinto Zipp, G. (2006). Applications of the mind map learning technique in chiropractic education: A pilot study and literature review. *Journal of Chiropractic Humanities*, 13, 2-11).

II. Methods.

A. Sample and Procedure.

The authors created a survey using ASSET, a university wide web-based survey tool. This study received approval from the Institutional Review Board at University. All CAPTE accredited PT academic program chairpersons received an email inviting them to participate in the study with instructions on how to access the survey via a hyperlink directed to the Seton Hall University Asset survey host. In 2010, all CAPTE accredited Physical Therapy programs chairpersons information ($n= 191$) was accessed via the APTA website. Participation in the study was completely voluntary and anonymous as the survey did not request participants to submit any personal or professional identifying characteristics. Physical Therapist program chairs were specifically surveyed given their responsibilities in overseeing curricular plans, syllabi, faculty assignments, and annual program review which would require explicit knowledge of all teaching strategies used by program faculty, thus enabling them to effectively respond to survey questions. The survey host (ASSET, SHU) stored the survey responses until they were downloaded by the researchers in aggregate format. Data from completed surveys were analyzed using SPSS Version 15.0.

B. Study Design.

The study utilized a descriptive, explorative survey research design. This descriptive, cross-sectional, survey design fit the aims of this study as it allowed the researchers to describe faculty utilization and knowledge of mind mapping in physical therapy curricula. Additionally, qualitative analyses of emergent themes from open ended questions posed within the survey were reviewed in order to provide greater insight into faculty perceptions regarding teaching and learning strategies specifically, mind mapping and concept maps. Participant's responses were coded for emerging themes and organized into sub-categories under each theme.

C. Survey Development.

To develop a valid survey questionnaire a modified Delphi consensus method was used consisting of five physical therapists with expertise in research design and survey development. Of the five Delphi panelists, four had used mind maps and concept maps in their teaching.

The Delphi technique has been used frequently in the literature to achieve consensus on an issue from a panel of experts, to collect an opinion on priorities in research or practice, to validate concepts or theoretical constructs (Bisset, Cusik, & Adamson, 2002), and to obtain content validity of survey items or measures on a researcher developed tool as was the case in this study (Biondo, et al., 2008; Falzarano, 2011; Falzarano & Pinto Zipp, 2012). Generally, the Delphi technique uses a series of questions seeking controlled feedback in attempt to seek the most reliable consensus among a group of experts in a specified area (Linstone & Turoff, 1975). For this study, the authors requested feedback on each question's appropriateness, clarity, and sequencing to the overall survey. Experts individually responded to the questions posed. In the literature it is suggested that survey developers using the Delphi approach review all expert responses and then modify the tool based upon the need to reach a pre-determined percent agreement. While the literature does not suggest a set percent agreement, many studies use 80%

(Keeney, Hasson, & McKenna, 2006) as was the case in this study. The revised survey is then sent out to the same experts for a second round of review on those survey questions, which required modifications in order to reach 80% agreement on question appropriateness, clarity, and or sequence. This process of review and revision is continued for several rounds until the set percent agreement has been met. In this study, the expert Delphi panel engaged in two rounds at which time 80% agreement was achieved on all individual questions. Lindeman (1981) suggested that the Delphi approach provides objectivity to the outcomes based upon the participant's lack of inhibition from the group process.

D. Survey Instrument.

Following an introductory statement on what a mind map is and a visual representation of a mind map, participants were asked to answer an initial question regarding the use of mind maps within their curriculum. If they responded "yes" to using mind maps they were directed via the electronic survey to complete 18 questions regarding the utility of mind maps within their program (Section 1). The 18 questions required either a "yes" / "no" response or statements regarding their application of mind maps. Those participants who indicated that they did not use mind maps in their curriculum were asked to identify barriers as to why they did not use mind maps.

All participants were asked to complete the second section of the survey that contained demographic questions used to provide verification of the sample meeting the inclusion criteria. Only those respondents who used mind maps were asked to complete the third section of the survey which contained four open ended questions: how do you define mind maps?, how do you define concept maps?, does your program use concept maps?, and how does your program use mind maps?

III. Results.

A. Response Rate.

Of the 191 physical therapist education program chairs who were emailed a request to participate in the survey, 55 valid responses were returned resulting in a 28.7% response rate. While there is no definitive required sample size for a survey (Kelly et al., 2003), the response rate obtained in this study represents approximately a third of all possible participants. The findings from this exploratory study, while offering insight, must be reviewed with caution as the sample who did respond that they used MM was much smaller than the group who responded that they did not use MM.

B. Demographic information.

Of the 55 respondents, the academic degrees awarded by institutions were the Doctor of Physical Therapy (n=53) and the Master of Physical Therapy (n=2). The physical therapist education programs were predominately three years in length (92.7%, n=51) with four programs being either four years (3.6%) or two years (3.6%) in length respectively. A majority of programs 58.2% (n=32) were not affiliated with a medical school. Potential regional differences were evaluated using the time zone of the program location. The time zone representing the largest

participant pool was eastern (67.3%) followed by central (20%), pacific (9.1%) and mountain 3.6% respectively (Table 1).

Table1. Demographics of Physical Therapy Program Respondents (n 55).

Academic Degree Awarded	Percentage	Number
Master of Physical Therapy	3.6%)	2
Doctor of Physical Therapy	96.4%	53
Affiliated with Medical School		
Yes	41.8%	23
No	58.2%	32
Length of Academic Program		
2 years	3.6%	2
3 years	92.8%	51
4 year	3.6%	2
Location of Program by Time Zone		
Eastern	67.3%	37
Central	20.0%	11
Pacific	9.1%	5
Mountain	3.6%	2

Faculty Utilization of Mind Maps. Respondents were asked to identify if their faculty utilized Mind Maps (MM) in their programs over the past ten years and if so to identify when, where, and how it was infused within the curriculum. While current program chairs may not have been acting in that capacity during the entire ten year period, they would have explicit knowledge of teaching strategies during that time frame based upon their access to the program's accreditation documents and annual review reports. Of the 55 respondents, only 10.9% (n=6) reported using MM within their curriculum. Of the six programs using MM, 42.9% (n=3) reported using them for less than a year and 42.9% (n=3) reporting using MM for less than five years. Respondents were asked to designate the course category for which MM are used with 7.3% (n=4) identifying clinical coursework, 5.5% (n=3) foundational science, and 1.8 % (n=1) teaching and learning coursework. No respondents identified using MM in management coursework. When asked how their program utilizes MM within these identified areas, 16.7% (n=1) required MM after assigned readings but prior to class lectures, 33.3 % (n=2) required students to develop MM after class lectures and 50% (n=3) required students to develop MM as an assignment which added to their course grade (Table 2).

When asked if course instructors reviewed MM with individual students, 33.3% (n=2) stated that they did. Interestingly, only 16.7 % (n=1) formally assess students' perceptions regarding the use of mind maps in their program (Table 3).

Table 2. How Mind Maps are utilized within coursework (valid percent).

	Yes	No
Require students develop mind maps after reading chapters but prior to class lecture	16.7% (n1)	83.3% (n5)
Require students develop mind maps after class lectures	33.3 % (n2)	66.7% (n 4)
Require students develop mind maps as percentage of course grade	50% (n3)	50% (n3)

Table 3. Faculty assessment of student developed mind maps (valid percent).

	Yes	No
Formally assess student's perceptions of Mind Maps as a teaching/learning strategy	16.7% (n 1)	83.3% (n 4)
Course instructors review Mind Maps individually with a student in an attempt to develop the depth of their learning	33.3% (n 2)	66.7% (n 4)

To better understand faculty perception's regarding how students perceive and utilize MM as a learning strategy, several questions were posed to the faculty who use MM (Table 4).

Table 4. PT faculty utilizing Mind Maps perceptions' of student perceived utility of MM as a learning strategy (valid percent).

Questions	Yes	No
Do students like the use of mind maps as a learning strategy?	60% (n3)	40% (n2)
Do students prefer mind maps over other educational strategies?	33.3% (n2)	66.7% (n4)
Students use their mind maps when reviewing for examinations and practical	100% (n6)	0.0%

The faculty respondents, who self-identified as not using mind maps within the PT curriculum, were asked to identify from a provided list of potential barriers which they perceived may have hampered their program's usage of MM. Of the 49 programs not using MM, 56.4% stated that their program faculty would be interested in using MM. Based upon the open ended responses from respondents not using MM, four themes emerged which may explain faculty lack of MM utilization, with limited awareness identified as the greatest barrier (Table 5).

Table 5. Barriers to mind mapping within Physical Therapy curriculum (percent agreement).

	Percent	Number
Limited awareness of how to utilize MM in the existing coursework	72.7%	40
Lack of perceived usefulness of MM in developing student's critical thinking	43.6%	24
Lack of evidence to support MM in developing student's critical thinking	41.8%	23
Faculty time constraints	40.0%	22

For the programs currently using MM, three open-ended questions were posed to provide insight into how they are defining and incorporating MM as a teaching and learning strategy. The first open-ended question asked, "How does your program use MM?" Based upon the participants' responses, three major themes emerged: (a) as an adjunct to promote integration of knowledge, (b) to review concepts, and (c) to help students visualize interrelationships between variables (i.e., topics, structures, concepts). To determine the respondent's recognition of the subtle but important differences between concept and mind mapping techniques, the second question asked, "How would you define the term concept maps?" Upon reviewing the responses (Table 6), it was evident that faculty were aware that concept maps link information in linear fashion.

Table 6. PT Faculty Responses to define Concept Maps (most frequent themes).

How would you define the term Concept Map?

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- *Similar to mind mapping in that it is a graphical representation of the interrelationship between concepts; used to show linkages in the development of knowledge*
 - *Identification of interrelated concepts and the relationship between them – often related to one particular concept or idea*
 - *Directional flow/linking word to concepts*
 - *Linear concept integration flow chart*
-

The final open-ended question asked, "How would you define the term MM? Based upon the participants' responses, several themes emerged that support MM being viewed as diagrammatic interrelationships, interrelated concepts, and visual pictorial concepts (Table 7).

Table 7. PT Faculty response to define Mind Map (most frequent themes).

How would you define the term Mind Map?

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- *Visual representation of interrelated contextual processes*
 - *Diagrammatic representation of the interrelationships between certain variables and specific central ideas (tasks, structures or words)*
 - *Identification of interrelated concepts and the relationships between them- broad connections*
 - *Visual pictorial non-linear graphic integration of concepts*
-

IV. Discussion.

To develop critical thinking skills in students, faculty must continue to explore and evaluate the efficacy of various teaching and learning strategies. The findings from this study support that PT educators are not currently using mind maps as a mechanism for transmitting and integrating information in physical therapy education programs. This prevalence data is the first of its kind on MM utility in physical therapy education and can be used to explore strategies to address the perceived barriers. The authors infer that more important than understanding the prevalence of MM usage is the study finding that PT faculty would be interested in learning more about MM as a teaching and learning strategy and its usefulness in evidence-based teaching and learning.

Emerging literature in higher education recognizes the MM as a potential teaching and learning strategy that actively engages the mapper (learner) in synthesizing and integrating information in a meaningful non-linear manner (D'Antoni et al., 2010; Farrand, Hussain, &

Hennessy, 2002; Pinto Zipp, Maher, & D'Antoni, 2009; Wickramasinghe et al., 2007). The self-identified relationships that the mapper constructs may support a richer and deeper integration of information resulting in the fostering of both declarative (explicit) and non-declarative procedural (implicit) knowledge for the promotion of critical thinking for long-term learning (Ambrose et al., 2010). Clearly, reflective critical thinking is one of the key dimensions of clinical reasoning capability used in physical therapy practice (Christensen et al., 2008).

As academicians in the health sciences, creating rich learning experiences for the development of critical thinking is imperative as it supports students' ability to effectively practice their craft as evidenced based autonomous clinicians.

Clearly, much work is needed to further support MM as a teaching and learning strategy that can foster critical thinking skill. Yet, informing faculty about the MM strategy and the available evidence may promote the use of MM as a teaching and learning strategy within physical therapist education programs and higher education in the health sciences (Edwards & Cooper, 2010; Kerns, Bush, & McCleish, 2006; Michelini, 2000). As scholars of teaching and learning, educating others on innovative teaching and learning strategies is part of our role as scholars while also seeking evidence for their implementation.

V. Conclusion.

Mind mapping, which uses a multi-sensory learning approach, can support a student's ability to explore associations amongst information because it is a "free-form" learning technique in which creative thinking is fostered (Davis, Sumara, & Luce-Kaper, 2000). For the learner, exploring these relationships engages a "deep" approach to learning rather than a "superficial dive" (Biggs, 1987). The interconnection created by the branches in the MM also allows for "dual coding" (Kullay, Lee, & Caterino, 1985) of information which supports association and links to be made. While future work is warranted to assess if student critical thinking skills are benefited by this approach, the findings from this study suggest that mind mapping is not widely used in physical therapist education but that faculty are interested in learning more about the tenets associated with MM. As scholars of teaching and learning, we must explore and then inform others of diverse teaching and learning strategies that may support the academy's role to enlighten students not only with knowledge but with the ability to act upon that knowledge.

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